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Bulletin 278 July 1937

Should Flax be Grown in Utah

R. W. WOODWARD, D. C. TINGEY
AND A. C. DILLMAN

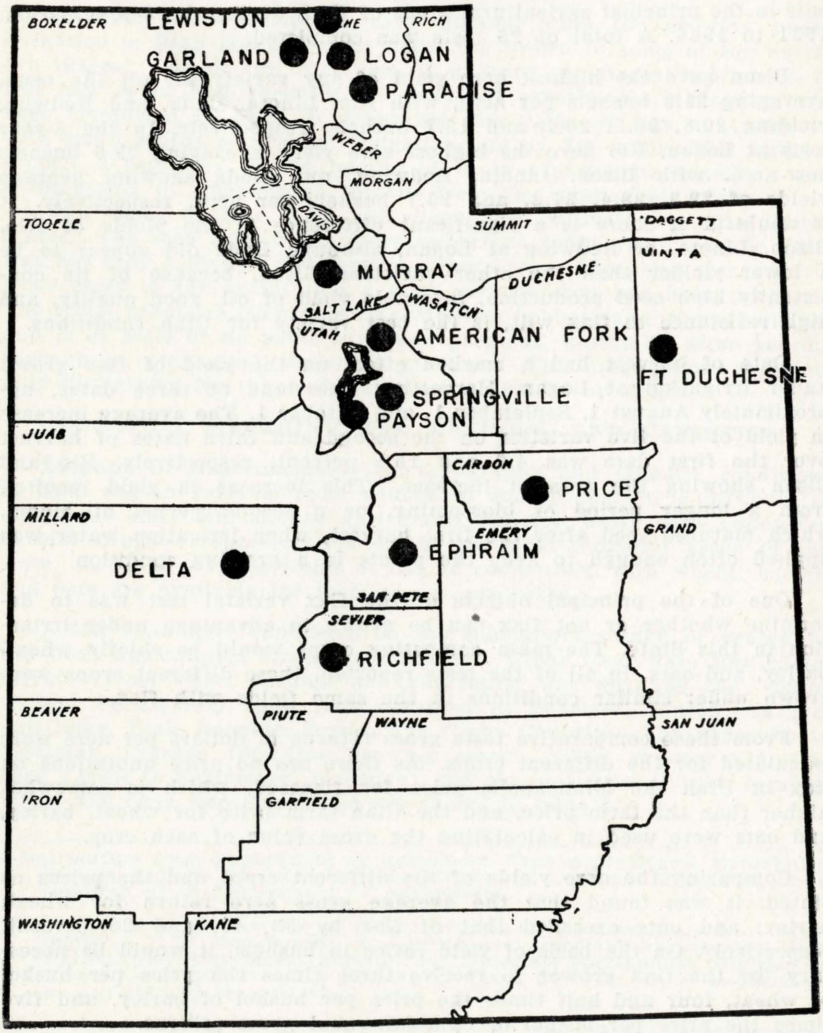

Figure 1.—Map of Utah, showing location of flax varietal tests

UTAH AGRICULTURAL EXPERIMENT STATION
UTAH STATE AGRICULTURAL COLLEGE
LOGAN, UTAH
In Cooperation with United States Department of Agriculture
Bureau of Plant Industry

SUMMARY

Five of the leading varieties of flax grown in the United States were tested for seed production in comparison with wheat, barley, and oats in the principal agricultural areas of Utah during the 6-year period, 1931 to 1936. A total of 28 tests was completed.

Bison gave the highest acre yield of any variety for all the tests, averaging 21.8 bushels per acre, with Rio, Linota, Buda, and Redwing yielding 20.8, 20.5, 20.4, and 18.7 bushels, respectively. In the 6-year tests at Logan, Rio gave the highest acre yield, averaging 29.6 bushels per acre, with Bison, Linota, Redwing, and Buda showing average yields of 29.3, 28.4, 27.2, and 25.7 bushels per acre, respectively. It is doubtful if there is a significant difference in the yields of Rio, Bison, Linota, or Redwing at Logan, although Buda did appear to be a lower yielder than the other varieties. Bison, because of its consistently high seed production, favorable yield of oil, good quality, and high resistance to flax wilt, is the best variety for Utah conditions.

Date of harvest had a marked effect on the yield of flax grown under irrigation at Logan. Harvesting was done at three dates, approximately August 1, September 1, and October 1. The average increase in yield of the five varieties on the second and third dates of harvest over the first date was 4.6 and 15.5 percent, respectively, Rio and Bison showing the greatest increase. This increase in yield resulted from a longer period of blossoming, or a second period of bloom, which matured seed after the first harvest, when irrigation water was applied often enough to keep the plants in a growing condition.

One of the principal objects of the flax varietal test was to determine whether or not flax can be grown to advantage under irrigation in this State. The main competing crops would be chiefly wheat, barley, and oats. In all of the tests reported, these different crops were grown under similar conditions in the same fields with flax.

From these comparative tests gross returns in dollars per acre were calculated for the different crops. As there are no price quotations on flax in Utah the Minneapolis price for flaxseed, which is somewhat higher than the farm price, and the Utah farm price for wheat, barley, and oats were used in calculating the gross value of each crop.

Comparing the acre yields of the different crops and the prices as stated, it was found that the average gross acre return for wheat, barley, and oats exceeded that of flax by 32, 49, and 20 percent, respectively. On the basis of yield ratios in bushels, it would be necessary for the flax grower to receive three times the price per bushel of wheat, four and half times the price per bushel of barley, and five times the price per bushel of oats for equal gross returns.

EXPERIMENTS WITH FLAX IN UTAH[1]

R. W. WOODWARD, D. C. TINGEY, AND A. C. DILLMAN[2]

INTRODUCTION

Flax has been considered as a possible crop for growing under irrigation in Utah because of its high acre return in some of the northern States. One of the functions of a State experiment station is to test new crops and varieties. A series of experiments, therefore, has been conducted in Utah to determine the yields of flax as compared with small grains both under irrigation and on dry lands. This bulletin reports a summary of the results of these experiments together with a discussion of comparative returns from flax and small grains.

Two types of flax, seed and fiber, are cultivated in the United States. The seed type is the more important commercially, while fiber flax has only a limited distribution. These types have been confused in some cases to the extent that a dual purpose crop has been proposed. The straw produced from seed flax varieties is short and of poor quality and is of little or no value for linen products, especially after passing through a commercial threshing machine. This publication considers only flax grown for the seed, called also flaxseed or linseed.

LOCATION, EXPERIMENTAL METHODS, AND VARIETIES

Location of Experiments.—The topography and climatic conditions of Utah are so variable from county to county that it is difficult to divide the state into similar agricultural regions. Tests were conducted in nine counties representative of the principal irrigated areas of the state. In eight counties yields of flax in comparison with wheat, barley, and oats are available for from one to six years.

A few tests were conducted on the substations owned or rented by the Utah Agricultural Experiment Station. Other tests were located on private farms where seeding and harvesting was done by the senior writer. Satisfactory tests were obtained in Boxelder, Uintah, Carbon, Salt Lake, Utah, Sanpete, Sevier, and Cache Counties. The approximate elevation, average frost-free growing season, mean summer temperature (April to September, inclusive) and the soil type at each location where the tests were conducted are shown in table 1.

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[1]Contribution from Department of Agronomy, Utah Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

[2]Junior Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture; Associate Agronomist, Utah Agricultural Experiment Station; and Associate Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, respectively.

The writers express their appreciation to the Sub-station superintendents who seeded and cared for the flax crops, Lemoyne Wilson, Sanpete; J. W. Carlson, Uintah Basin; I. D. Zobell, Carbon County; and George Whornham, Millard County; and to cooperating farmers, G. Kasworm, Salt Lake County; Ralph Richards, Boxelder County; John Alleman, Abner Baird, and Raleigh Williams, Utah County; and to Mr. T. H. Hooper, Chemistry Department, North Dakota Agricultural Experiment Station for chemical analysis of flax samples reported herein.

Publication authorized by the Director.

Table 1.—Elevation, mean temperature (April to September, inclusive), soil type and average frost-free growing season in each county where flax, wheat, barley, and oats have been tested.

Station	County	Elevation (ft.)	Mean temperature April to Sept., incl.	Soil Type	Length of growing season (days)
Logan	Cache	4600	61.7	Millville silty clay loam	140
Lewiston	Cache	4520		Trenton fine sandy loam	
Avon	Cache	4600		Millville silty clay loam	
Garland	Boxelder	4500	63.9	Heavy soil*	119
Ft. Duchesne	Uintah	4900	61.0	Navajo clay	131
Price	Carbon	5500	61.6	Billings loam	126
Murray	Salt Lake	4265	64.0	Welby loam	127
American Fork	Utah	4700	64.2	Manila silty loam	132
Payson	Utah	4600		Heavy soil*	
Springville	Utah	4500	64.2	Black Peaty soil*	120
Ephraim	Sanpete	5600	59.8	Clay*	116
Richfield	Sevier	5400	60.8	Red heavy soil*	109
Delta	Millard	4500	62.3	Oasis clay	118

*Not officially classified

Location of State: Latitude 37° to 42° North
Longitude 108.5° to 114° West

Field Methods.—Five varieties of flax were grown in comparison with small grains in the several counties. Each variety of flax was grown in 3-row plots 17 feet long, with the rows 1 foot apart and the plots replicated five times. The plots were arranged in the order of a Latin square, that is, in a manner to minimize the effect of soil variation. At the Experiment Farm at North Logan, however, 7-row plots were grown, making it possible to harvest row 2 from each of the five plots for the first date of harvest, row 4 for the second harvest date, and row 6 for the third date. This method provided one guard row on each side of the row harvested. The seed was sown at the rate of 40 pounds per acre except on dry land where a 25-pound rate was used. The seeding was done with a garden drill. Two to four irrigations were applied each season on the irrigated land.

Since flax does not compete with weeds as effectively as small grains, it was necessary to cultivate and weed the flax more often than the small grains.

At harvest, 16 feet of the middle row of each 3-row plot was cut and taken to Logan for threshing. A few farmers grew small field plots from time to time with estimated acre yields of 15 to 20 bushels.

The average yield of all five flax varieties is shown in comparison with the average yield of Federation and Dicklow wheats, Trebi barley, and Swedish Select oats. It should be kept in mind that the flax and small grains were grown in the same nursery, under similar conditions of soil and irrigation, and, therefore, the yields are comparable. This does imply, of course, that similar yields could be obtained on a field scale without the same care in soil preparation, irrigation, and weed control.

Varieties Grown.—The varieties of flax grown were Bison, Linota, Redwing, Buda, and Rio. Bison is highly wilt-resistant and is grown extensively in Minnesota and the Dakotas. Rio is a large-seeded selection of Argentine flax. Linota and Redwing are small seeded, early maturing varieties. However, data obtained at Logan over a 6-year period showed an average of only four days difference in ripening between the earliest and latest varieties. The varieties of grain grown in all experiments were Federation and Dicklow wheats, Trebi barley, and Swedish Select oats.

EXPERIMENTAL RESULTS

Flax was found to be variable in its growth responses. The type of soil, mean temperatures, water supply, and other assocaied factors resulted in considerable differences in height, extent of branching, and seed yields. In some areas vigorous vegetative growth resulted, while at others growth was rather stunted.

At the time of full bloom the flax nursery at Logan had a dense uniform growth. Although the rows were 1 foot apart they could scarcely be identified. Height of plant varied from 25 to 33 inches, depending on season and variety. The extra vegetative growth seemed to be more pronounced in sections where the nights were cool.

CACHE COUNTY

The most complete data available were recorded at the Experiment Farm. Nurseries were grown successfully during each of the six years.

North Logan.—The average yield of the five flax varieties for the 6-year period was 27.5 bushels per acre as compared with wheat at 62.1 bushels, barley at 85.0, and oats 111.6 bushels. (Tables 2 and 3).

Table 2.—Yield of flax varieties at the Experiment Farm, North Logan, Utah, 1931-36.

Variety	C.I.	Date		Height	Yield (Bu. per acre)						
		Full bloom	Fully ripe		1931	1932	1933	1934	1935	1936	Avg.
		June	Aug.	(In.)							
Rio	280	11	9	26	15.7	30.1	22.7	42.1	33.7	32.0	29.4
Bison	389	12	8	27	17.9	27.9	21.3	40.6	29.8	38.1	29.3
Buda	326	15	7	26	16.7	25.6	21.2	35.6	26.1	31.9	26.2
Linota	244	14	11	29	16.7	26.8	21.1	41.1	32.4	32.0	28.4
Redwing	320	8	10	26	15.3	27.9	20.8	35.6	30.6	30.4	26.8
Average all varieties	....	....	....	....	16.5	27.7	21.4	39.0	30.5	32.9	28.0

Table 3.—Annual and average yield of five flax varieties in experiments in eight counties.

County	Yield (Bu. per acre)					
	Rio	Bison	Redwing	Linota	Buda	Avg.
Uintah						
1931	35.5	33.1	30.3	33.2	32.6	32.9
1932	31.4	32.0	29.9	31.3	38.9	30.7
1933	24.1	25.8	22.4	20.5	22.0	23.0
1934	17.4	21.2	18.9	21.6	20.0	19.8
Average	27.1	28.0	25.4	26.7	25.9	26.6
Salt Lake						
1932	30.5	25.8	24.2	21.6	27.2	25.9
1933	20.8	18.9	13.9	16.8	16.0	17.3
1934	29.7	28.2	23.4	24.2	25.8	25.3
1935	19.8	21.9	16.9	19.9	19.1	19.5
Average	25.2	23.7	19.6	20.6	22.0	22.3
Boxelder						
1933	12.1	10.7	9.0	10.1	11.4	10.7
1934	26.6	27.8	20.1	25.7	30.1	26.1
1935	24.4	26.0	19.6	23.1	27.2	24.1
Average	21.0	21.5	16.2	19.6	22.9	20.3
Carbon						
1931	11.8	11.0	11.4	11.1	13.6	11.8
1932	18.2	17.0	15.6	17.4	20.7	17.8
1933	17.1	18.4	17.1	18.1	17.6	17.7
Average	15.7	15.5	14.7	15.5	17.3	15.8
Utah						
1932	18.3	24.6	12.4	23.6	20.4	19.9
1933	9.0	9.5	7.1	6.6	7.7	8.0
1935	1.3	5.0	2.6	4.0	5.1	3.6
Average	9.5	13.0	7.4	11.4	11.1	10.5
Sanpete						
1932	18.9	17.7	11.8	16.1	17.3	16.4
1933	20.3	21.0	20.3	21.1	19.1	20.4
Average	19.6	19.4	16.1	18.6	18.2	18.4
Sevier						
1935	16.6	17.1	17.3	15.0	15.6	16.3
Cache (Lewiston)						
1933	11.0	11.8	9.8	14.4	10.3	11.5
Cache dry farm (Avon)						
1934	10.1	10.7	7.5	9.0	9.7	9.4

Lewiston.—Flax was grown at Lewiston on fertile, well-drained sandy soil. Although average yields were only 11.5 bushels an acre this test was not considered representative of that area, because yields were reduced by damage from poultry and by excessive shading.

Paradise.—A flax nursery was grown on a dry-land farm near Paradise, in 1934. Soil moisture conditions were favorable for good germination. The season of 1934 apparently was more favorable to flax than average years, as shown by the results obtained on irrigated land. (Table 2.) The average yield of flax on the dry farm was 9.4 bushels an acre, while the estimated yields of winter wheat on the same farm were from 30 to 35 bushels an acre. Another flax test on dry land near Newton gave unsatisfactory results, no yield data being recorded.

BOXELDER COUNTY

Flax was grown on the same farm near Garland for the 3-year period, 1933 to 1935. The soil was a heavy clay loam and highly productive as measured by the yields of field crops grown in the area. Flax yields were consistently good although they were not equal to those at Logan. The small grain yields were high, the wheat yielding 60.4 bushels an acre as compared to 20.2 bushels for the five flax varieties over the same 3-year period. The results of these tests by years are shown in Table 3. In this county the yield of flax as compared with wheat was 1 to 3, barley 1 to 5.2, and oats 1 to 6.5, respectively (Table 4). On a price basis, the ratio of wheat to flax is 1 to 2.3; barley to flax 1 to 3.1, and oats to flax 1 to 4. The greater yields of wheat, barley, and oats were more than enough, therefore, to offset the higher price of flax.

SALT LAKE COUNTY

In Salt Lake County tests were conducted on fertile soil at Murray. Although extra care was given the plots each year, the height of the flax plants was decidedly less than in Cache, Uintah or Sanpete Counties. The five flax varieties gave an average yield of 22.2 bushels an acre while spring wheat averaged 63.7 bushels. (Table 4.)

Table 4.—Average yields of flax, wheat, barley, and oats, and the comparative yield ratios by counties, 1931-36.

County	Flax	Wheat	Barley	Oats	Ratio flax to cereals (Bushel yields 1931-36)		
					Wheat	Barley	Oats
Cache	28.0	62.1	85.0	111.6	1:2.2	1:3.0	1:4.0
Boxelder	20.3	60.4	105.0	131.0	1:3.0	1:5.2	1:6.5
Uintah	26.6	77.9	122.7	126.9	1:2.9	1:4.6	1:4.8
Salt Lake	22.3	63.7	90.0	107.0	1:2.9	1:4.1	1:4.8
Carbon	15.8	53.2	89.2	88.1	1:3.4	1:5.7	1:5.6
Sanpete	18.4	71.0	96.2	87.2	1:3.9	1:5.2	1:4.7
Utah	10.5	46.0	62.7	74.7	1:4.4	1:6.0	1:7.1
Sevier	16.3	75.0			1:4.6		
Average	19.8	63.7	93.0	103.8	1:3.4	1:4.7	1:5.3

UTAH COUNTY

In only one year (1932) out of four were flax varietal tests satisfactory in Utah County. The tests were in a different locality in the county each year. The test was not well cared for in 1933, and the crop was a complete failure in 1934 owing to drought and lack of irrigation water. In 1935 a heavy growth of weeds resulted in low yields. Small grains invariably produced better than flax under these poor conditions. The average yield of Dicklow and Federation wheat for the two years, 1932 and 1935, was 46.0 bushels an acre as compared to 11.9 bushels of flax. (Table 3.) If flax had been given the same care here as in other counties, yields probably would have been higher.

CARBON COUNTY

The varietal tests were conducted on the Sub-Experiment Farm four miles south of Price. Flax varieties did surprisingly well on the alkaline soils of this farm. Average acre yields for the 3-year test were 15.7 bushels of flax as compared with 53.2 bushels of wheat, 89.2 bushels of barley, and 88.1 bushels of oats grown under similar conditions. (Tables 3 and 4.)

UINTAH COUNTY

The 4-year average yield of the five flax varieties grown on fertile soil on the Experiment Farm at Fort Duchesne, was 26.6 bushels an acre, whereas Federation and Dicklow wheats yielded 77.9 bushels for the same period. (Table 3.) The yield ratio of flax to wheat was approximately 1 to 3 in this county, as was common in most tests under irrigation.

SANPETE COUNTY

At the Sanpete Experiment Farm, located on peat soil near Ephraim, the flax varieties gave a 2-year average yield of 18.4 bushels an acre, while standard varieties of wheat, barley, and oats yielded 71.0, 96.2, and 87.2 bushels, respectively. (Table 3.)

SEVIER COUNTY

Flax data for only one year are available in Sevier County. The soil in general is productive under irrigation, and high yields of small grains and corn have been obtained from varietal tests located at Richfield. The average yield of flax in 1935 was 16.3 bushels an acre as compared with 75 bushels for wheat. (Table 3.) The barley and oat nurseries were destroyed by birds.

MILLARD COUNTY

Flax tests were sown two years at Delta. The plantings were made on heavy soil, high in soluble salts. Although a good stand was secured, the plants died after reaching a height of a few inches. The killing of the plants appeared to be associated with accumulation of alkali salts at the surface of the soil, at which point the stems first turned dark.

EFFECT OF LATE IRRIGATION AND TIME OF HARVEST ON THE YIELD OF FLAX

As previously stated, yields were obtained on the middle row of each 3-row plot. After the regular harvest in 1932, at Logan, the

remaining rows in the flax nursery were accidentally irrigated. Within a short time a second bloom occurred, almost equivalent to the first in general appearance. The season was relatively cool with occasional rains, and the flax plants continued to grow after the first or main crop of bolls had ripened.

Several weeks after the regular harvest a second harvest of the border rows was made and the yields were found to exceed those of the first harvest. Probably the increase in yield cannot be wholly accounted for by the second bloom as it may have resulted from the additional light and root space available following the removal of the middle rows in the first harvest. Delayed harvest, however, seemed to offer a possibility of increasing the yield. Subsequent tests were designed, therefore, to allow three dates of harvest with each harvested row protected by a guard row on each side as in the regular 3-row plots. This experiment was conducted at Logan for four seasons, 1933 to 1936, inclusive.

Rows 2, 4, and 6 of each 7-row plot were harvested at three successive dates, as previously described. Approximate dates of harvest during the four years were August 1, September 1, and October 1. (Table 5.)

As flax was found to shatter very little, any second bloom, induced by late irrigation, might increase the yield. The two varieties with highest average yields for normal harvests, Bison and Rio, also gave consistently higher increases in yield when forced to a second bloom. The average increase of these varieties was nearly 24 percent, whereas Linota, Buda, and Redwing showed an average increase of only 9 percent. (Table 5.) The oil content and drying quality of the oils (iodine number) was almost identical for each date of harvest in 1934, as shown at the bottom of table 6.

The flax is grown on the irrigated lands of Utah, where sufficient water is available, the increase shown by Rio and Bison might warrant delaying the harvest. It should be recognized, however, that if harvest is delayed too late, the drying of the crop is greatly retarded and may result in difficulties in handling and threshing the crop.

Table 5.—Average yields in bushels per acre at three dates of harvest of five flax varieties, grown four years at Logan, Utah, each variety replicated five times. (Three complete harvests made.)

Variety	C.I. no.	Approximate date of harvest			Average yield	Increase of second harvest over first		Increase of third harvest over first	
		Aug. 1	Sept. 1	Oct. 1	(Bu.)	Bu.	%	Bu.	%
Rio	280	30.5	33.6	38.3	34.1	3.1	10.2	7.8	25.6
Bison	389	31.3	34.0	38.3	34.5	2.7	8.6	7.0	22.4
Linota	244	31.1	33.2	33.9	32.7	2.1	6.8	2.8	9.0
Buda	326	27.7	29.4	30.8	29.3	1.7	6.1	3.1	11.2
Redwing	320	28.3	30.5	30.2	29.7	2.2	7.8	1.9	6.7
Average		29.8	32.1	34.3	32.1	2.3	7.9	4.5	15.0

YIELD AND QUALITY OF OIL

Flaxseed is the source of two valuable products—linseed oil and linseed meal. Ordinarily, the oil represents about two-thirds of the value of the two products and the linseed meal about one-third. The percentage yield of oil may range from 33 to 40 percent or more, depending on the variety of flax and the climatic conditions under which the crop is grown. The flaxseed grown in these experiments produced a very satisfactory yield and good drying quality of oil.

The chemist uses the "iodine number" as a measure of the drying

Table 6.—Oil content and iodine number of the oils of four varieties of flax grown in cultivated rows under irrigation, 1932-1936. (Analyses by Professor T. H. Hooper, Agricultural Experiment Station, Fargo, North Dakota.)

		Oil content, percent (on 8% moisture basis)				Iodine number of oil (Wijs method)			
		Rio	Bison	Linota	Red-wing	Rio	Bison	Linota	Red-wing
Cache (Logan)	1932	40.3	38.9	35.6	36.6	182	183	191	193
	1933	38.7	37.9	34.7	36.2	174	175	186	188
	1934	39.7	38.3	35.3	36.7	179	179	188	189
	1935	39.6	38.6	35.3	36.9	176	177	187	188
	1936	38.7	39.5	36.7	37.6	172	178	190	191
Salt Lake	1932	39.2	38.0	34.4	35.9	179	181	190	191
	1934	39.1	38.0	35.1	36.7	180	178	192	193
	1935	59.3	38.7	34.9	37.1	176	180	190	192
Uintah	1931	40.6	38.9	36.0	37.8	174	177	187	187
	1932	40.0	38.7	35.6	36.7	179	181	191	192
	1933	38.6	37.8	34.7	36.0	170	172	185	184
	1934	40.0	38.5	35.7	36.8	176	176	187	189
Utah	1932	39.2	38.0	34.1	35.6	180	180	188	188
Sanpete	1932	39.3	37.0	34.0	35.7	174	172	183	185
Carbon	1933	39.8	38.1	34.4	35.3	179	177	186	187
Five counties*	1933	38.4	37.2	34.5	35.3	173	173	182	185
Boxelder	1935	40.5	38.8	35.8	37.4	182	182	191	191
Average (all tests)		39.4	38.3	35.1	36.4	177	178	188	189
Date of harvest Logan, 1934									
Aug. 9		39.7	38.3	35.3	36.7	179	179	188	189
Sept. 8		39.8	38.1	35.3	36.7	180	178	187	189
Sept. 28		39.5	38.3	35.3	36.5	178	179	188	189

*Composite sample from Boxelder Cache (Lewiston), Salt Lake, Sanpete, and Utah counties, crop of 1933.

quality of linseed oil or other drying oils. The iodine number is a measure of the quantity of oxygen the oil will absorb in drying to form a characteristic paint film. A higher iodine number indicates an oil of good drying quality. The federal standards for raw linseed oil specify an iodine number of 177 or higher on government purchases. The oil content of the seed of four varieties of flax grown in these experiments, and the iodine number of the oils, is shown in table 6. As mentioned above, the oil content and drying quality of the oils purchased produced from flaxseed grown under irrigation in Utah has been very satisfactory. The oil content has averaged nearly 2 percent greater and the iodine number from 10 to 20 points higher than obtained from seed of the same varieties grown during the same years in the principal flaxseed producing states. It should be said, however, that the past six years have been abnormally dry and unfavorable for flax in the principal flax producing states.

SHOULD FLAX BE GROWN IN UTAH?

The production of flax as a home industry in Utah has been proposed from time to time by commercial interests. The experiments reported in this bulletin were conducted in order to determine what yields of flaxseed may be expected in comparison with standard varieties of wheat, oats, and barley, the principal competing crops. As the farm equipment used in seeding, harvesting, and threshing flax is the same as that used for small grains there should be little difference in the cost of production. Flax, however, requires extra labor in the control of weeds, either by means of a good crop rotation or by extra tillage, and this would add something to the cost of production.

The problem, however, appears to be a question of economics. What acreage of flax would be required to supply a small linseed mill? If a commercial linseed mill used 300,000 bushels of flaxseed annually, this would require 20,000 acres of flax at an average yield of 15 bushels per acre. Can the State afford to divert 20,000 acres of irrigated land from other crops to the production of flax? Under present conditions approximately a million bushels of feed grains are shipped into the State each year as feed for livestock. Would it not be sound economy to grow this grain at home by increasing the acreage of oats and barley?

Table 7.—Comparative average yield and computed gross income from flax, wheat, barley, and oats in 28 tests during the 6-year period, 1931 to 1936.

Variety	Acre Yield	Average farm price 1931-1936	Averages gross returns per acre (Dollars)	(P ct.)	Ratio of flax yields to grain yields	Ratio Price of grain to price of flax
	(Bu.)	(Dollars)				
Flax	19.8	1.64*	32.47	100	....	....
Wheat	63.7	0.71	45.23	139	1:3.2	1:2.3
Barley	93.0	0.53	49.29	152	1:4.7	1:3.1
Oats	103.8	0.40	41.52	128	1:5.2	1:4.1

*Minneapolis market price 1931 to 1936.

If flax were grown for a market outside the State the freight would be a considerable item of expense to growers. The nearest market would be San Francisco, California, or Fredonia, Kansas. The rate on flaxseed in car lots to these points is about 28 cents per bushel. The handling charge at a local elevator probably would be 7 cents a bushel or more, making the total cost of shipment approximately 35 cents a bushel.

Since yields are available from 28 tests in which flax, wheat, barley, and oats were grown on the same fields in eight counties for one to six years, it is possible to compare gross acre returns based on comparative yields and prices. These comparisons have been made as shown in table 7.

Average Utah farm prices for the 6-year period, 1931 to 1936, were used in computing the gross returns for wheat, barley, and oats. As no prices for flax are available in this State the Minneapolis market price for flaxseed during the same 6-year period has been used. This price is from 10 to 30 cents higher than farm prices in the flax-producing states, and considerably higher than could be expected for Utah grown flaxseed shipped to the nearest present market. Assuming that a market did exist in Utah, with prices equal to those paid at Minneapolis, the relative gross acre returns from flax would be much less than from grain crops as shown in table 7.